USB2080

User's Manual

Beijing ART Technology Development Co., Ltd.

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Chapter 1 Overview

In the fields of Real-time Signal Processing, Digital Image Processing and others, high-speed and high-precision data acquisition modules are demanded. ART USB2080 data acquisition module, which brings in advantages of similar products that produced in china and other countries, is convenient for use, high cost and stable performance.

ART USB2080 is a data acquisition module based on USB bus. It can be directly inserted into computer's USB interface which is compatible with USB2080 to constitute the laboratory, product quality testing center and systems for different areas of data acquisition, waveform analysis and processing. It may also constitute the monitoring system for industrial production process.

Unpacking Checklist

Check the shipping carton for any damage. If the shipping carton and contents are damaged, notify the local dealer or sales for a replacement. Retain the shipping carton and packing material for inspection by the dealer.
Check for the following items in the package. If there are any missing items, contact your local dealer or sales.

- USB2080 Data Acquisition Board
- ART Disk
  a) user's manual (pdf)
  b) drive
  c) catalog
- Warranty Card

FEATURES

Analog Input

- Converter Type: AD7899-1 or AD7899-2
- Input Range: AD7899-1: ±10V, ±5V
  AD7899-2: 0~5V, 0~2.5V
- 14-bit resolution
- Sampling Rate: 138Hz~400KHz
- Analog Input Mode: 32SE/16DI
- Analog Input Impedance: 100MΩ
- Analog Input Common-mode Voltage Range: <± 2V
- Clock Source: internal clock
- Trigger Mode: software trigger, hardware trigger (external trigger)
- Trigger Type: level trigger , edge trigger
- Trigger Direction: negative, positive, either positive or negative trigger
- Trigger Source DTR Input Range: standard TTL level
- On-board Memory: 96K word FIFO
- Programmable Gain: 1, 2, 4, 8 (AD8251 default)or 1, 2, 5, 10 (AD8250) or 1, 10, 100, 1000 (AD8253)
- Analog Input Impedance: 10MΩ
- Amplifier Set-up Time: 785nS(0.001%)(max)

- Non-linear error: ±1LSB(Maximum)
- System Measurement Accuracy: 0.05%
- Operating Temperature Range: 0℃~55℃
- Storage Temperature Range: −20℃~70℃

Digital Input

- Channel No.: 8-channel
- Electric Standard: TTL compatible
- Maximum Sink Current: less than 0.5 mA
- High Voltage: ≧2V
- Low Voltage: ≦0.8V

Digital Output

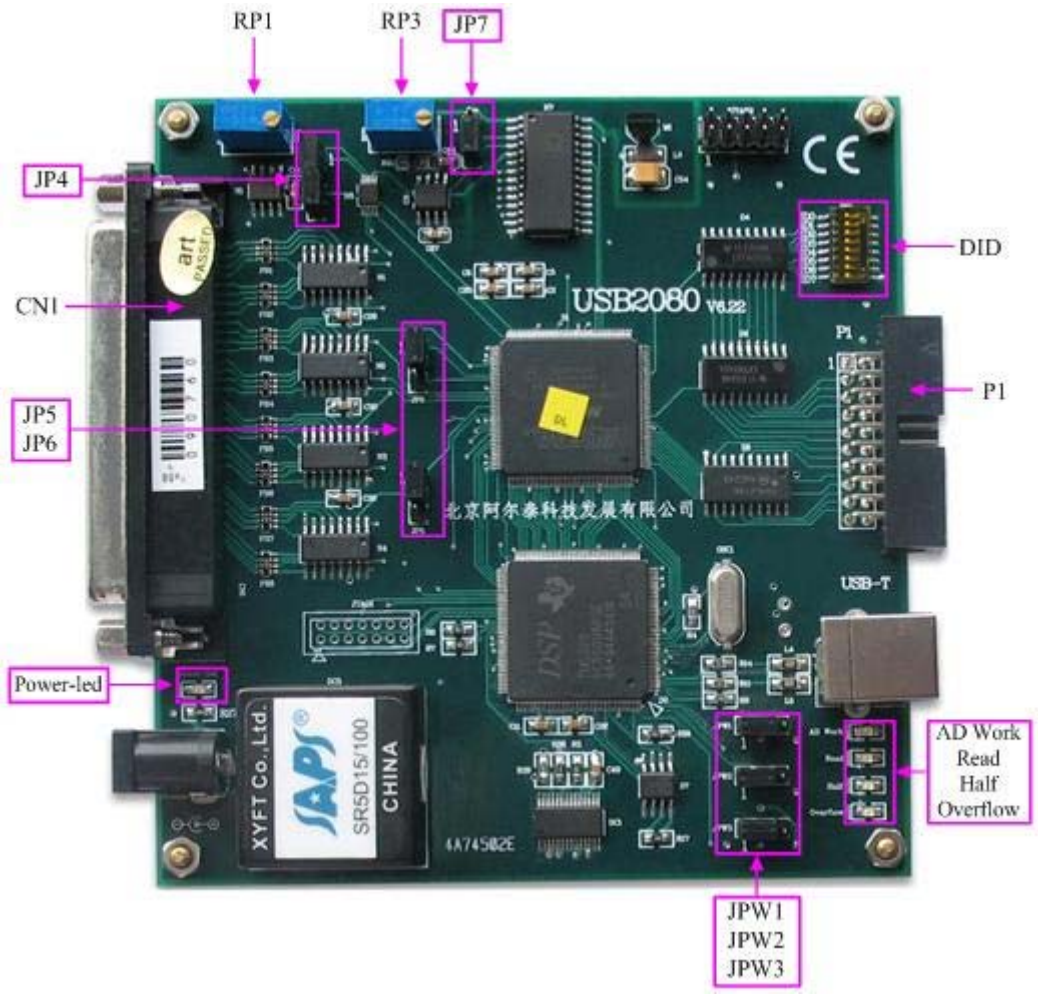
- Channel No.: 8-channel
- Electrical Standard: TTL compatible
- Maximum Pull-down Current: 20mA
- Maximum Pull-up Current: 2.6mA
- High Voltage: ≧3.4V
- Low Voltage: ≦0.5V

Dimension

108.5mm (L) x 114.4mm (W) x 17mm (H)

Chapter 2 Components Layout Diagram and a Brief Description

2.1 The Main Component Layout Diagram



2.2 The Function Description for the Main Component

2.2.1 Signal Input and Output Connectors

CN1: Analog input connector
P1: Digital signal input and output connector
DID: Device Physics ID

2.2.2 Potentiometer

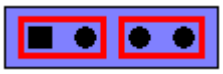
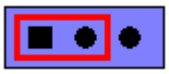
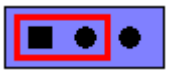
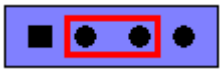
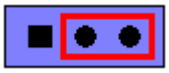
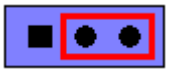
RP1: Analog signal input zero-point adjustment potentiometer

RP3: Analog signal input full-scale adjustment potentiometer

2.2.3 Jumper

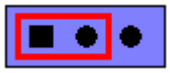
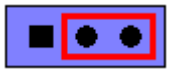
JP4, JP5, and JP6: Analog signal input single-ended, double-end selection
JP7: Analog signal input range selection
JPW1, JPW2, and JPW3: DSP loader mode selection, 1-2 pins shorted (default)
JTAG1, JTAG2: The connector which is used to write logic device

Analog input single-ended and double-ended selection

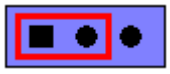
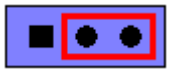
Selection	JP4	JP5	JP6
SE			
DI			

Analog signal output range selection

AD7899-1

Range Selection	JP7
±10V	
±5V	

AD7899-2

Range Selection	JP7
0～5V	
0～2.5V	

2.2.4 Status indicator

AD Work: AI working status indicator, on for normal condition.
Read: Data reading indicator.
Half: Data buffer "half-full" indicator, on for half-full status.
power-led: power indicator, on for normal condition.

2.2.5 Physical ID of DID

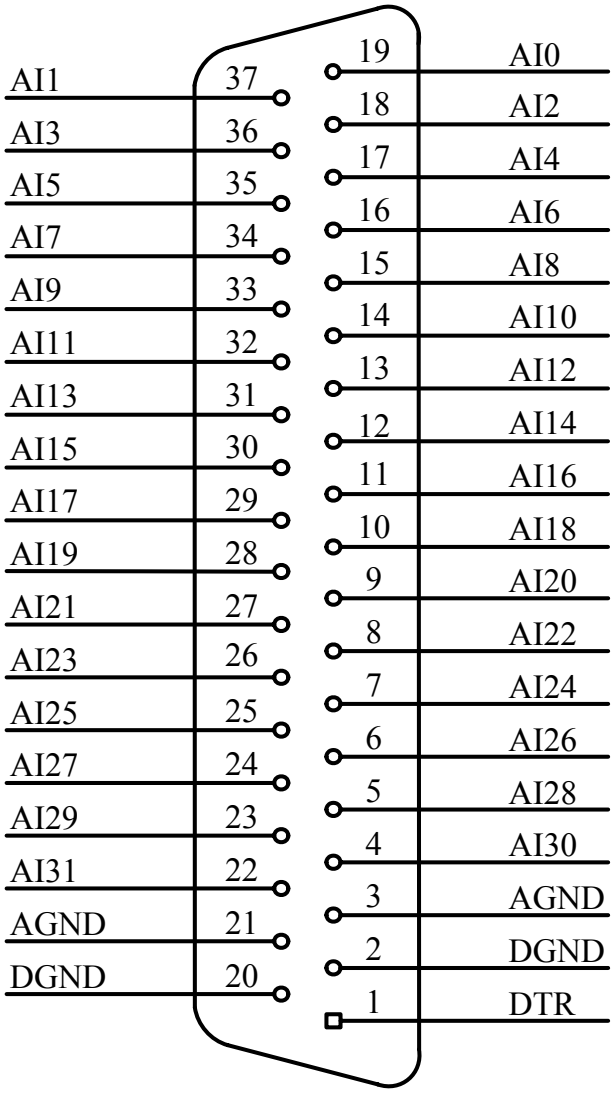
DID: Set physical ID number, only the low 4 bits are effective, 16 physical ID number can be selected. DID points to "ON", that means "1", and when it points to the other side, that means "0."

ID3	ID2	ID1	ID0	ID Number
OFF(0)	OFF(0)	OFF(0)	OFF(0)	0H
OFF(0)	OFF(0)	OFF(0)	ON(1)	1H
OFF(0)	OFF(0)	ON(1)	OFF(0)	2H
OFF(0)	OFF(0)	ON(1)	ON(1)	3H
OFF(0)	ON(1)	OFF(0)	OFF(0)	4H
OFF(0)	ON(1)	ON(0)	ON(1)	5H
OFF(0)	ON(1)	ON(1)	OFF(0)	6H
OFF(0)	ON(1)	ON(1)	ON(1)	7H
ON(1)	OFF(0)	OFF(0)	OFF(0)	8H
ON(1)	OFF(0)	OFF(0)	ON(1)	9H
ON(1)	OFF(0)	ON(1)	OFF(0)	AH
ON(1)	OFF(0)	ON(1)	ON(1)	BH
ON(1)	ON(1)	OFF(0)	OFF(0)	CH
ON(1)	ON(1)	OFF(0)	ON(1)	DH
ON(1)	ON(1)	ON(1)	OFF(0)	EH
ON(1)	ON(1)	ON(1)	ON(1)	FH

Chapter 3 Signal Connectors

3.1 The Definition of Analog Signal Input and Output Connector

37 core plug on the CN1 pin definition

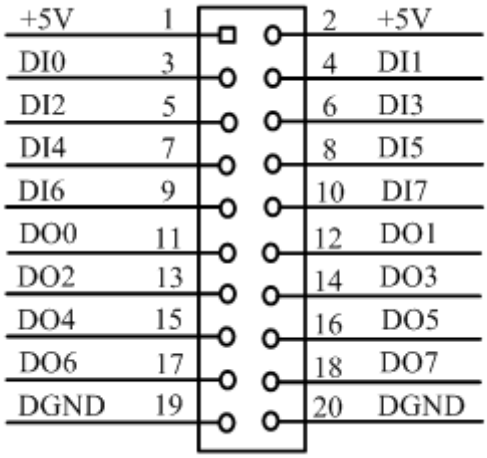


Pin definition about CN1:

Pin name	Type	Pin function definition
AI0~AI31	Input	AD analog input, reference ground is AGND.
AGND	GND	Analog ground. This AGND pin should be connected to the system's AGND plane.
DGND	GND	Digital ground. Ground reference for Digital circuitry. This DGND pin should be connected to the system's DGND plane.
DTR	Input	Digital trigger signal input, reference ground is DGND.

3.2 The Definition of Digital Signal Input and Output Connector

20 core plug on the P1 pin definition



Pin definition about P1:

Pin name	Type	Pin function definition
DI0~DI7	Input	Digital input
DO0~DO7	Output	Digital output
+5V	Output	Power output 5V (max 100 mA)
DGND	GND	Digital signals ground

Chapter 4 Connection Ways for Each Signal

4.1 Analog Input Single-ended Connection

Single-ended mode can achieve a signal input by one channel, and several signals use the common reference ground. This mode is widely applied in occasions of the small interference and relatively many channels.

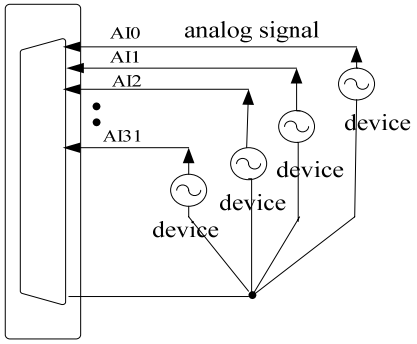


Figure 4.1 single-ended input connection

4.2 Analog Input Differential-ended Mode

Double-ended input mode, which was also called differential input mode, uses positive and negative channels to input a signal. This mode is mostly used when biggish interference happens and the channel numbers are few. Single-ended/double-ended mode can be set by the software, please refer to USB2080 software manual.

According to the diagram below, USB2080 board can be connected as analog voltage double-ended input mode, which can effectively suppress common-mode interference signal to improve the accuracy of acquisition. Positive side of the 16-channel analog input signal is connected to AI0~A15, the negative side of the analog input signal is connected to AI16~AI31, equipments in industrial sites share the AGND with USB2080 board.

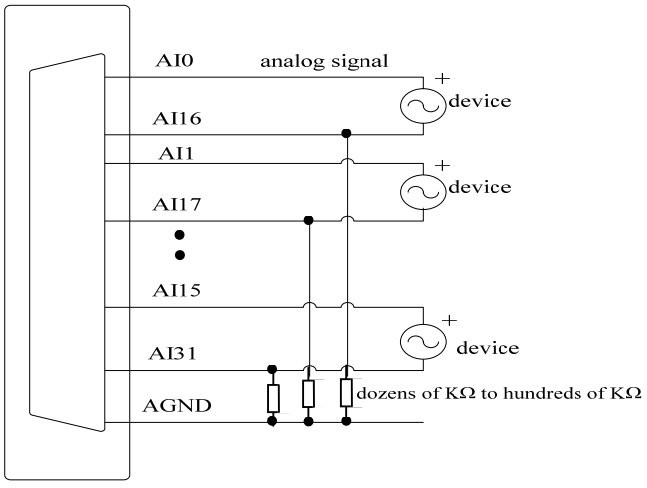


Figure 4.2 double-ended input connection

4.3 Other Connections

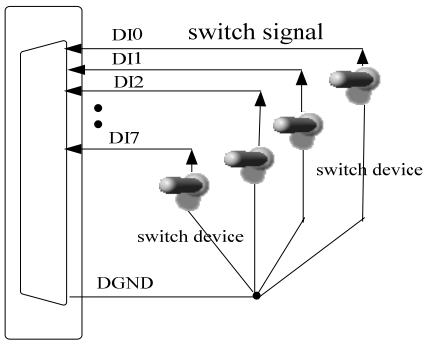


Figure 4.3 digital signal input connection

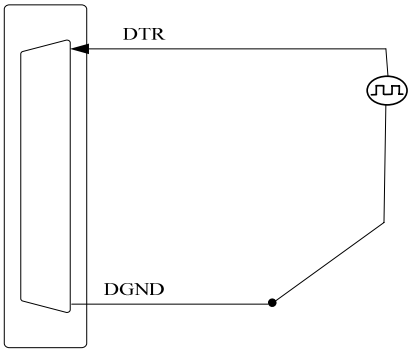


Figure 4.5 trigger Signal Connection

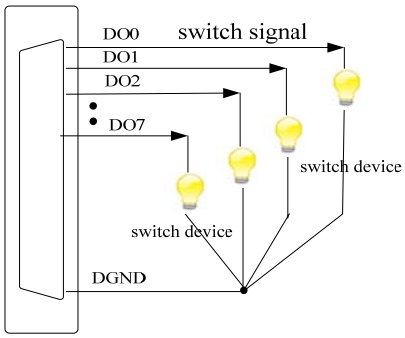


Figure 4.4 digital signal output connection

Chapter 5 The Instruction of the Trigger Function

5.1 Internal Trigger Mode

When A/D is in the initialization, if the hardware parameter ADPara.TriggerMode = USB2080_TRIGMODE_SOFT, we can achieve the internal trigger acquisition. In this function, when calling the InitDeviceAD function, it will generate A/D start pulse, A/D immediately access to the conversion process and not wait for the conditions of any other external hardware. It also can be interpreted as the software trigger.

As for the specific process, please see the figure below, the cycle of the A/D work pulse is decided by the sampling frequency.

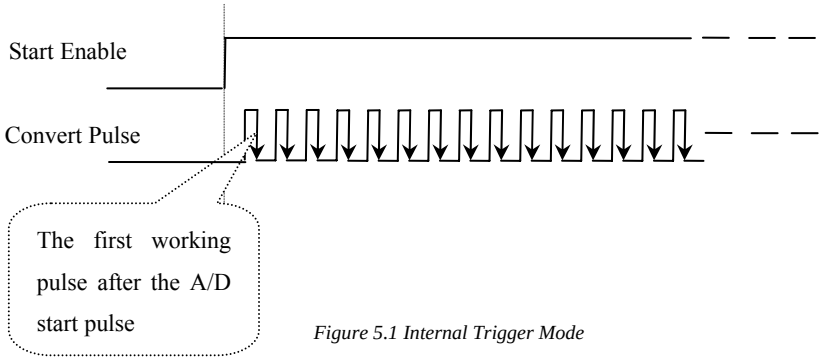


Figure 5.1 Internal Trigger Mode

5.2 External Trigger Mode

When A/D is in the initialization, if the A/D hardware parameter ADPara.TriggerSource = USB2080_TRIGSRC_OUT, we can achieve the external trigger acquisition. In this function, when calling the InitDeviceAD function, A/D will not immediately access to the conversion process but wait for the external trigger source signals accord with the condition, then start converting the data. It also can be interpreted as the hardware trigger. Trigger source includes the DTR (Digital Trigger Source).

When the trigger signal is the digital signal (standard TTL-level), using the DTR trigger source.

(1) Edge trigger function

Edge trigger is to capture the characteristics of the changes between the trigger source signal and the trigger level signal to trigger A/D conversion.

When ADPara.TriggerDir = USB2080_TRIGDIR_NEGATIVE, choose the trigger mode as the falling edge trigger. That is, when the DTR trigger signal is on the falling edge, A/D will immediately access to the conversion process, and its follow-up changes have no effect on A/D acquisition.

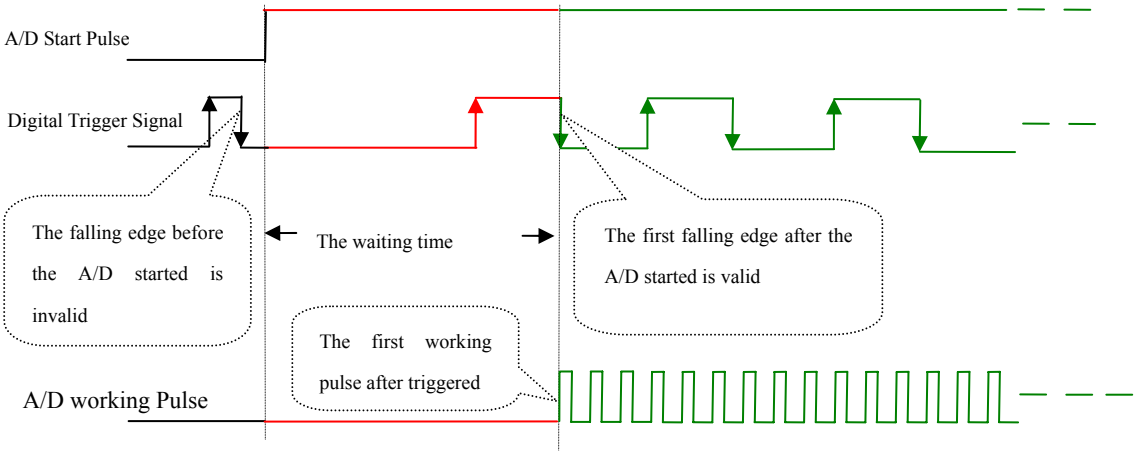

A/D Start Pulse
Digital Trigger Signal
The falling edge before the A/D started is invalid
The waiting time
The first falling edge after the A/D started is valid
The first working pulse after triggered
A/D working Pulse

Figure 5.2 Falling edge Trigger

When ADPara.TriggerDir = USB2080_TRIGDIR_POSITIVE, choose the trigger mode as rising edge trigger. That is, when the DTR trigger signal is on the rising edge, A/D will immediately access to the conversion process, and its follow-up changes have no effect on A/D acquisition.

When ADPara.TriggerDir = USB2080_TRIGDIR_POSIT_NEGAT, choose the trigger mode as rising or falling edge trigger. That is, when the DTR trigger signal is on the rising or falling edge, A/D will immediately access to the conversion process, and its follow-up changes have no effect on A/D acquisition. This function can be used in the case that the acquisition will occur if the exoteric signal changes.

（2）Level trigger function

Level trigger is to capture the condition that trigger signal is higher or lower than the trigger level to trigger A/D conversion.

When ADPara.TriggerDir = USB2080_TRIGDIR_NEGATIVE, it means the trigger level is low. When DTR trigger signal is in low level, A/D is in the conversion process, once the trigger signal is in the high level, A/D conversion will automatically stop, when the trigger signal is in the low level again, A/D will re-access to the conversion process, which is, only converting the data when the trigger signal is in the low level.

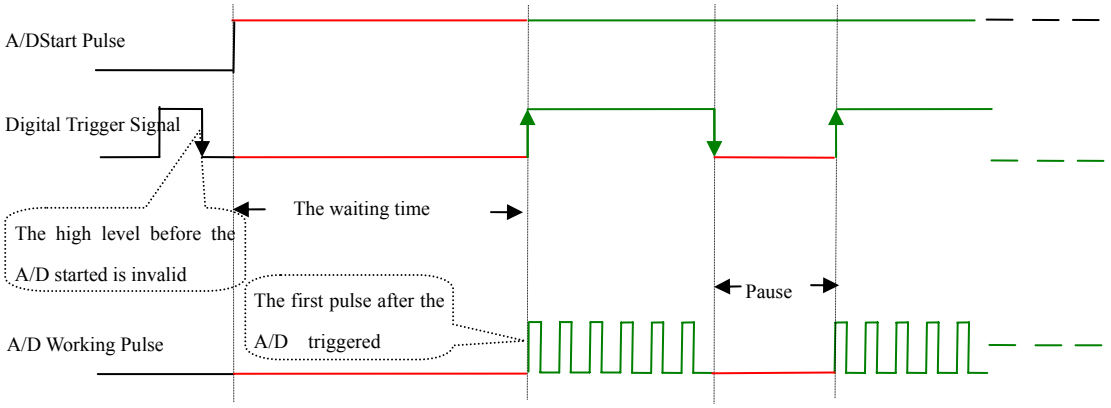


Figure 5.3 High Level Trigger

When ADPara.TriggerDir = USB2080_TRIGDIR_POSITIVE, it means the trigger level is high. When DTR trigger signal is in high level, A/D is in the conversion process, once the trigger signal is in the low level, A/D conversion will automatically stop, when the trigger signal is in the high level again, A/D will re-access to the conversion process, which is, only converting the data when the trigger signal is in the high level.

When ADPara.TriggerDir = USB2080_TRIGDIR_POSIT_NEGAT, it means the trigger level is low or high. The effect is the same as the internal software trigger.

Chapter 6 Methods of using Internal and External Clock Function

6.1 Internal Clock Function

Internal Clock Function refers to the use of on-board clock oscillator and the clock signals which are produced by the user-specified frequency to trigger the A/D conversion regularly. To use the clock function, the hardware parameters ADPara.ClockSouce= USB2080_CLOCKSRC_IN should be installed in the software. The frequency of the clock in the software depends on the hardware parameters ADPara.Frequency. For example, if Frequency = 100000, that means A/D work frequency is 100000Hz (that is, 100 KHz, 10μs /point).

6.2 Methods of Using Continuum and Grouping Sampling Function

6.2.1 Continuum Sampling Function

The continuous acquisition function means the sampling periods for every two data points are completely equal in the sampling process of A/D, that is, completely uniform speed acquisition, without any pause, so we call that continuous acquisition.

To use the continuous acquisition function, the hardware parameters ADPara.ADMode = USB2080_ADMODE_SEQUENCE should be installed in the software. For example, in the internal clock mode, hardware parameters ADPara.Frequency = 100000 (100KHz) should be installed, and 10 microseconds after the A/D converts the first data point, the second data point conversion starts, and then 10 microseconds later the third data point begins to convert, and so on.

The formula for calculating the external signal frequency is as follows:

Under the internal clock mode:

External signal frequency = A/D sampling frequency/（cycle signal points × the total number of sample channels）

External signal cycle = 1 / external signal frequency

Under the external clock mode:

External signal frequency = external clock frequency/(cycle signal points × the total number of sample channels)

External signal cycle = 1 / external signal frequency

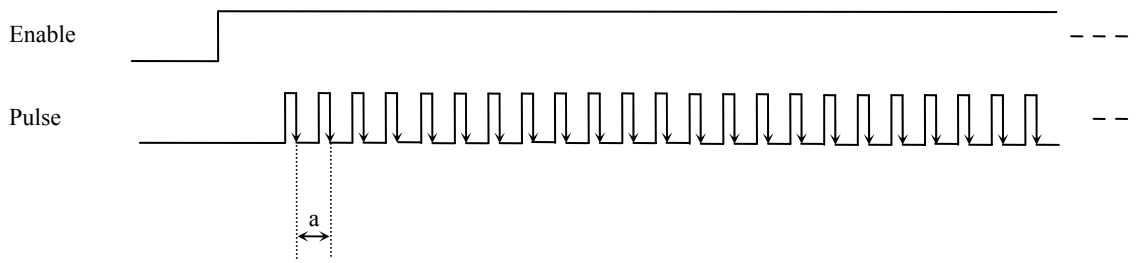


Figure 6.1 collecting continuum sampling in internal clock mode

Note: a－sampling cycle

6.2.2 Grouping Sampling Function

Grouping acquisition (pseudo-synchronous acquisition) function refers to the sampling clock frequency conversion among the channels of the group in the AD sampling process, and also a certain waiting time exists between every two groups, this period of time is known as the Group Interval. Loops of group refer to numbers of the cycle acquisition for each channel in the same group. In the internal clock mode and the fixed-frequency external clock mode, the time between the groups is known as group cycle. The conversion process of this acquisition mode as follows: a short time stop after the channels conversion in the group (that is, Group Interval), and then converting the next group, followed by repeated operations in order, so we call it grouping acquisition.

The purpose of the application of the grouping acquisition is that: at a relatively slow frequency, to ensure that all of the time difference between channels to become smaller in order to make the phase difference become smaller, thus to ensure the synchronization of the channels, so we also say it is the pseudo-synchronous acquisition function. In a group, the higher the sampling frequency is, the longer Group Interval is, and the better the relative synchronization signal is. The sampling frequency in a group depends on ADPara. Frequency, Loops of group depends on ADPara.LoopsOfGroup, the Group Interval depend on ADPara. Group Interval.

Based on the grouping function, it can be divided into the internal clock mode and the external clock mode. Under the internal clock mode, the group cycle is decided by the internal clock sampling period, the total number of sampling channels, Loops of group and Group Interval together. In each cycle of a group, AD only collects a set of data. Under the external clock mode, external clock cycle ≥ internal clock sampling cycle × the total number of sampling channels × Loops of group + AD chip conversion time, AD data acquisition is controlled and triggered by external clock. The external clock mode is divided into fixed frequency external clock mode and unfixed frequency external clock mode. Under the fixed frequency external clock mode, the group cycle is the sampling period of the external clock.

The formula for calculating the external signal frequency is as follows:

Under the internal clock mode:
Group Cycle = the internal clock sampling period × the total number of sample channels × Loops of group + AD chips conversion time + Group Interval
External signal cycle = (cycle signal points / Loops of group) × Group Cycle
External signal frequency = 1 / external signal cycle

Under the external clock mode: (a fixed-frequency external clock)
Group Cycle = external clock cycle
External signal cycle = (cycle signal points / Loops of group) × Group Cycle
External signal frequency = 1 / external signal cycle

Formula Notes:

The internal sampling clock cycle = 1 / (AD Para. Frequency)
The total number of sampling channels = AD Para. Last Channel – AD Para. First Channel + 1
Loops of group == ADPara.LoopsOfGroup
AD Chips conversion time = see "AD Analog Input Function" parameter
Group Interval = AD Para. Group Interval
Signal Cycle Points = with the display of the waveform signal in test procedures, we can use the mouse to measure the signal cycle points.

Under the internal clock mode, for example, sample two-channel 0, 1, and then 0 and 1 become a group. Sampling frequency (Frequency) = 100000Hz (cycle is 10μs), Loops of group is 1, Group Interval = 50μs, then the acquisition process is to collect a set of data first, including a data of channel 0 and a data of channel 1. We need 10uS to sample the two data, 20μs to convert the data from the two channels. After the conversion time of an AD chip, AD will automatically cut-off to enter into the waiting state until the 50μs group interval ends. We start the next group, begin to convert the data of channel 0 and 1, and then enter into the waiting state again, and the conversion is going on in this way, as the diagram following shows:

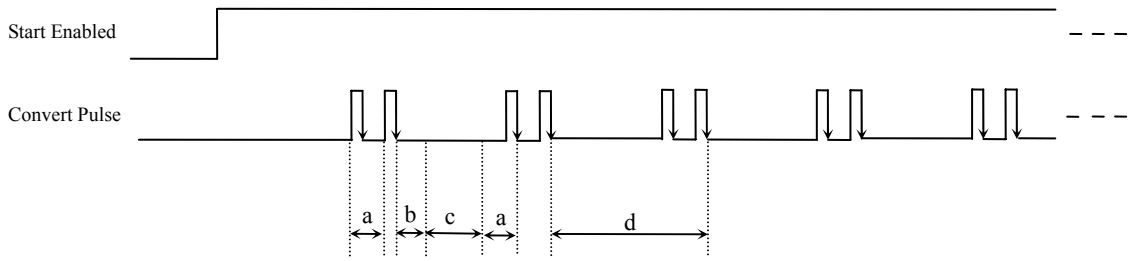


Figure 6.1 Grouping Sampling which grouping cycle No is 1 under the Internal Clock Mode

Note: a— internal clock sample cycle
b— AD chips conversion time
c—Group Interval
d— group cycle

Change the loops of group into 2, then the acquisition process is to collect the first set of data, including two data of channel 0 and two data of channel 1, the conversion order is 0,1,0,1. We need 10μs to sample each of the four data. After the conversion time of an AD chip, AD will automatically stop to enter into the waiting state until the 50μs Group Interval ends. We start the next group, begin to convert the data of channel 0 and 1, and then enter into the waiting state again, and the conversion is going on in this way, as the diagram following shows:

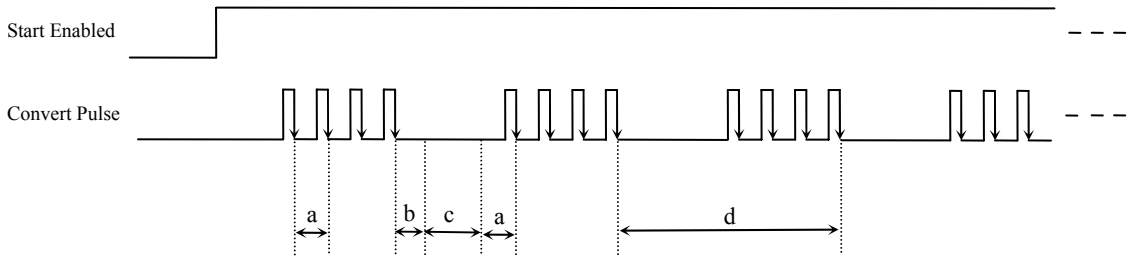


Figure 6.2 Grouping Sampling which grouping cycle No is 2 under the Internal Clock Mode

Notes: a— internal clock sample cycle
b— AD chips conversion time
c—Group Interval
d— group cycle

Chapter 7 Notes, Calibration and Warranty Policy

7.1 Notes

In our products' packing, user can find a user manual, a USB2080 module and a quality guarantee card. Users must keep quality guarantee card carefully, if the products have some problems and need repairing, please send products together with quality guarantee card to ART, we will provide good after-sale service and solve the problem as quickly as we can.

When using USB2080, in order to prevent the IC (chip) from electrostatic harm, please do not touch IC (chip) in the front panel of USB2080 module.

7.2 Analog Signal Input Calibration

Every device has to be calibrated before sending from the factory. It is necessary to calibrate the module again if users want to after using for a period of time or changing the input range. In the manual, we introduce how to calibrate USB2080 in ±5V, calibrations of other input ranges are similar.

Prepare a digital voltage instrument which the resolution is more than 5.5 bit, install the USB2080 module, and then power on, warm-up for fifteen minutes.

1) Zero adjustment: select one channel of analog inputs, take the channel AI0for example, connect 0V to AI0, and then run ART Data Acquisition Measurement Suite in the WINDOWS. Choose channel 0, ±10V input range and start sampling, adjust potentiometer RP1 in order to make voltage value is 0.000V or about 0.000V. Zero adjustment of other channels is alike.
2) Full-scale adjustment: select one channel of analog inputs, take the channel AI0 for example, connect 4999.89mV to AI0, and then run ART Data Acquisition Measurement Suite in the WINDOWS. Choose channel 0, ±5V input range and start sampling, adjust potentiometer RP2 in order to make voltage value is 4999.89mV or about 4999.89mV. Full-scale adjustment of other channels is alike.
3) Repeat steps above until meet the requirement.

7.3 Warranty Policy

Thank you for choosing ART. To understand your rights and enjoy all the after-sales services we offer, please read the following carefully.

1. Before using ART's products please read the user manual and follow the instructions exactly. When sending in damaged products for repair, please attach an RMA application form which can be downloaded from: www.art-control.com.

2. All ART products come with a limited two-year warranty:

- The warranty period starts on the day the product is shipped from ART's factory
- For products containing storage devices (hard drives, flash cards, etc.), please back up your data before sending them for repair. ART is not responsible for any loss of data.
- Please ensure the use of properly licensed software with our systems. ART does not condone the use of pirated software and will not service systems using such software. ART will not be held legally responsible for products

shipped with unlicensed software installed by the user.

3. Our repair service is not covered by ART's guarantee in the following situations:
   - Damage caused by not following instructions in the User's Manual.
   - Damage caused by carelessness on the user's part during product transportation.
   - Damage caused by unsuitable storage environments (i.e. high temperatures, high humidity, or volatile chemicals).
   - Damage from improper repair by unauthorized ART technicians.
   - Products with altered and/or damaged serial numbers are not entitled to our service.
4. Customers are responsible for shipping costs to transport damaged products to our company or sales office.
5. To ensure the speed and quality of product repair, please download an RMA application form from our company website.

Products Rapid Installation and Self-check

Rapid Installation

Product-driven procedure is the operating system adaptive installation mode. After inserting the disc, you can select the appropriate board type on the pop-up interface, click the button【driver installation】; or select CD-ROM drive in Resource Explorer, locate the product catalog and enter into the APP folder, and implement Setup.exe file. After the installation, pop-up CD-ROM, shut off your computer, insert the USB card. If it is a USB product, it can be directly inserted into the device. When the system prompts that it finds a new hardware, you do not specify a drive path, the operating system can automatically look up it from the system directory, and then you can complete the installation.

Self-check

At this moment, there should be installation information of the installed device in the Device Manager (when the device does not work, you can check this item.). Open "Start -> Programs -> ART Demonstration Monitoring and Control System -> Corresponding Board -> Advanced Testing Presentation System", the program is a standard testing procedure. Based on the specification of Pin definition, connect the signal acquisition data and test whether AD is normal or not. Connect the input pins to the corresponding output pins and use the testing procedure to test whether the switch is normal or not.

Delete Wrong Installation

When you select the wrong drive, or viruses lead to driver error, you can carry out the following operations: In Resource Explorer, open CD-ROM drive, run Others-> SUPPORT-> USB.bat procedures, and delete the hardware information that relevant to our boards, and then carry out the process of section I all over again, we can complete the new installation.